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## Executive Summary

**T**he *NMC Horizon Report* series is the most visible outcome of the NMC Horizon Project, an ongoing research effort established in 2002 that identifies and describes emerging technologies likely to have a large impact on teaching, learning, research, or creative expression within education around the globe. This volume, *The NMC Horizon Report: 2011 K-12 Edition* examines emerging technologies for their potential impact on and use in teaching, learning, and creative expression within the environment of pre-college education. The hope is that the report is useful to educators worldwide, and the international composition of the advisory board reflects the care with which a global perspective was assembled. While there are many local factors affecting the practice of education, there are also issues that transcend regional boundaries, questions we all face in K-12 education, and it was with these in mind that this report was created. *The NMC Horizon Report: 2011 K-12 Edition* is the third in the K-12 series of reports and is produced by the NMC in collaboration with the Consortium for School Networking (CoSN), and the International Society for Technology in Education (ISTE), with the generous support of HP's Office of Global Social Innovation.

Each edition of *The NMC Horizon Report* introduces six emerging technologies or practices that are likely to enter mainstream use in the educational community within three adoption horizons over the next one to five years. Each report also presents critical trends and challenges that will affect teaching and learning over the same time frame. To identify these areas, the project has drawn on an ongoing conversation among knowledgeable persons in the fields of business, industry, and education; on published resources, current research, and practice; and on the expertise of both the NMC community and the communities of the

members of the NMC Horizon Project's K-12 advisory board, an international body of experts in education, technology, and other fields.

The advisory board, chosen to broadly represent a range of perspectives in K-12 education, engaged in a discussion around a set of research questions intended to surface significant trends and challenges and to identify a wide array of potential technologies for the report.

***The NMC Horizon Report: 2011 K-12 Edition* examines emerging technologies for their potential impact on and use in teaching, learning, and creative expression within the environment of pre-college education.**

Over the course of a few weeks, the advisory board came to a consensus about the six topics that will appear here. The examples and readings under each topic area are meant to provide practical models as well as access to more detailed information. Wherever possible, an effort was made to highlight the innovative work going on among elementary, middle, and high schools around the world. The precise research methodology employed in producing the report is detailed in a special section that follows the body of the report.

The report's format is consistent from year to year, opening with a discussion of the trends and challenges identified

by the advisory board as the most important to consider over the next five years. The format of the main section closely reflects the focus of the NMC Horizon Project itself, centering on the applications of emerging technologies to education and creativity. Each topic is introduced with an overview that describes what it is, followed by a discussion of the particular relevance of the topic to teaching, learning, or creativity. Examples of how the technology is being, or could be applied to those activities are given. Finally, each section closes with an annotated list of suggested readings and additional examples that expand on the discussion in the report and a link to the project and discipline examples collected during the research process by project staff, the advisory board, and others in the growing NMC Horizon Project community.

## Key Trends

The technologies featured in each edition of *The NMC Horizon Report* are embedded within a contemporary context that reflects the realities of the time, both in the sphere of education and in the world at large. To

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assure this perspective, each advisory board researches, identifies, and ranks key trends that are currently affecting the practice of teaching, learning, and creativity, and uses these as a lens for its later work. These trends are surfaced through an extensive review of current articles, interviews, papers, and new research. Once identified, the list of trends is ranked according to how significant an impact they are likely to have on education in the next five years. The following five trends have been identified as key drivers of technology adoptions for the period of 2011 through 2016; they are listed here in the order they were ranked by the advisory board.

**1 The abundance of resources and relationships made easily accessible via the Internet is increasingly challenging us to revisit our roles as educators.** This multi-year trend was again ranked very highly, indicating

its continued influence. Institutions must consider the unique value that each resource adds to a world in which information is everywhere. In such a world, sense-making and the ability to assess the credibility of information are paramount. Mentoring and preparing students for the world in which they will live is again at the forefront.

**2 As IT support becomes more and more decentralized, the technologies we use are increasingly based not on school servers, but in the cloud.** The continuing acceptance and adoption of cloud-based applications and services is changing not only the ways we configure and use software and file storage, but even how we conceptualize those functions. It does not matter where our work is stored; what matters is that our information is accessible no matter where we are or what device we choose to use. Globally, in huge numbers, we are growing accustomed to a model of browser-based software that is device-independent. While some challenges still remain, specifically with notions of privacy and control, the promise of significant cost savings is an important driver in the search for solutions.

**3 Technology continues to profoundly affect the way we work, collaborate, communicate, and succeed.** Increasingly, technology skills are also critical to success in almost every arena, and those who are more facile with technology will advance while those without access or skills will not. The digital divide, once seen as a factor of wealth, is now seen as a factor of education: those who have the opportunity to learn technology skills are in a better position to obtain and make use of technology than those who do not. Evolving occupations, multiple careers, and an increasingly mobile workforce contribute to this trend.

**4 People expect to be able to work, learn, and study whenever and wherever they want to.** This highly ranked trend, also noted last year, continues to permeate all aspects of daily living. Life in an increasingly busy world where learners must balance demands from home, work, school, and family poses a host of logistical challenges with which mobile students must cope. A faster approach is often perceived as a better approach, and as such people want easy

and timely access not only to the information on the network, but to their social networks that can help them to interpret it and maximize its value. The implications for informal learning are profound, as are the notions of “just-in-time” learning and “found” learning, both ways of maximizing the impact of learning by ensuring it is timely and efficient.

**5 The perceived value of innovation and creativity is increasing.** Innovation is valued at the highest levels of business and must be embraced in schools if students are to succeed beyond their formal education. The ways we design learning experiences must reflect the growing importance of innovation and creativity as professional skills. Innovation and creativity must not be linked only to arts subjects, either; these skills are equally important in scientific inquiry, entrepreneurship, and other areas as well.

## Critical Challenges

Along with current trends, the advisory board notes critical challenges that schools face, especially those that are likely to continue to affect education over the five-year time period covered by this report. Like the trends, these are drawn from a careful analysis of current events, papers, articles, and similar sources, as well as from the personal experience of the advisory board members in their roles as leaders in education and technology. Those challenges ranked as most significant in terms of their impact on teaching, learning, and creative inquiry in the coming years are listed here, in the order of importance assigned them by the advisory board.

**1 Digital media literacy continues its rise in importance as a key skill in every discipline and profession.** The challenge is due to the fact that despite the widespread agreement on its importance, training in digital literacy skills and techniques is rare in teacher education and school district professional development programs. As teachers begin to realize that they are limiting their students by not helping them to develop and use digital media literacy skills across the curriculum, the lack of formal training is being offset through professional development or informal learning, but we are far from seeing digital media literacy as a norm. This

challenge is exacerbated by the fact that digital literacy is less about tools and more about thinking, and thus skills and standards based on tools and platforms have proven to be somewhat ephemeral.

**2 Economic pressures and new models of education are presenting unprecedented competition to traditional models of schools.** Across the board, institutions are looking for ways to control costs while still providing a high quality of service. Schools are challenged by the need to support a steady — or growing — number of students with fewer resources and staff than before. As a result, creative institutions

## Digital literacy is less about tools and more about thinking.

are developing new models to serve students, such as providing open content over the network. As these pressures continue, other models may emerge that diverge from traditional ones. Simply capitalizing on new technology, however, is not enough; the new models must use these tools and services to engage students on a deeper level.

**3 The demand for personalized learning is not adequately supported by current technology or practices.** The increasing demand for education that is customized to each student’s unique needs is driving the development of new technologies that provide more learner choice and control and allow for differentiated instruction. It has become clear that one-size-fits-all teaching methods are neither effective nor acceptable for today’s diverse students. Technology can and should support individual choices about access to materials and expertise, amount and type of educational content, and methods of teaching.

**4 A key challenge is the fundamental structure of the K-12 education establishment — aka “the system.”** As long as maintaining the basic elements of the existing system remains the focus of efforts to support education, there will be resistance to any profound change in practice. Learners have increasing

opportunities to take their education into their own hands, and options like informal education, online education, and home-based learning are attracting students away from traditional educational settings. If the system is to remain relevant it must adapt, but major change comes hard in education.

**5 Many activities related to learning and education take place outside the walls of the classroom and thus are not part of our learning metrics.** Students can take advantage of learning material online, through games and programs they may have on systems at home, and through their extensive — and constantly available — social networks. The experiences that happen in and around these venues are difficult to tie back to the classroom, as they tend to happen serendipitously and in response to an immediate need for knowledge, rather than being related to topics currently being studied in school.

These trends and challenges are having a profound effect on the way we experiment with, adopt, and use emerging technologies. These aspects of the world that surround and permeate education serve as a framework for considering the probable impacts of the emerging technologies listed in the sections that follow.

## Technologies to Watch

The six technologies featured in *The NMC Horizon Report* are placed along three adoption horizons that indicate likely time frames for their entrance into mainstream use for teaching, learning, or creative applications in the K-12 environment. The near-term horizon assumes the likelihood of entry into the mainstream for schools within the next twelve months; the mid-term horizon, within two to three years; and the far-term, within four to five years. It should be noted that *The NMC Horizon Report* is not a predictive tool. It is meant, rather, to highlight emerging technologies with considerable potential for our focus areas of teaching, learning, and creative expression. Each of them is already the focus of work at a number of innovative schools around the world, and the work we showcase here reveals the promise of a wider impact.

### Near-term Horizon

On the near-term horizon — that is, within the next 12 months — are cloud computing and mobiles. Both appeared in *The NMC Horizon Report: 2010 K-12 Edition*, and their reappearance here is not only an indication of continued interest in these technologies but, more significantly, that the technologies continue to evolve. The strong interest in cloud computing has shifted from its previous focus on free productivity tools to a way to trim the costs of running district data centers, such as data storage, backups, and infrastructure maintenance. Mobiles, on the other hand, have moved to the near-term horizon this year as new, always-connected tablets such as the iPad have changed the debate around allowing personal devices on campuses.

> **Cloud computing** has already transformed the way users of the Internet think about computing and communication, data storage and access, and collaborative work. Cloud-based applications and services are available to many school students today, and more schools are employing cloud-based tools all the time. Now schools are looking to outsource significant parts of their infrastructure, such as email and backups, to cloud providers. Together, these developments have contributed considerably to the adoption of cloud computing approaches at K-12 schools across the globe.

> **Mobiles** are a category that defies long-term definitions. With more than 1.2 billion new mobile devices produced each year, the pace of innovation in the mobile markets is unprecedented. Mobiles, especially smartphones and tablets, enable ubiquitous access to information, social networks, tools for learning and productivity, and hundreds of thousands of custom applications. Mobiles were listed in previous years because they could capture multimedia, access the Internet, or geolocate. Now they are effectively specialized computers for the palm of your hand, with a huge and growing collection of software tools that make use of their accelerometers, compasses, cameras, microphones, GPS, and other sensors.

## Second Adoption Horizon

The second adoption horizon is set two to three years out, where we will begin to see widespread adoptions of two technologies with a growing importance: game-based learning and open content. Games are clearly part of mainstream popular culture; consumer use of open content is growing. Both have been demonstrated as effective tools for learning in a number of schools already, and both are expected to see much broader use in pre-college education over the next two to three years. Game-based learning also appeared on the mid-term horizon in *The NMC Horizon Report: 2010 K-12 Edition*. While continuing to develop in some very interesting ways, the growth of game-based learning has been constrained due to the lack of quality educational games and game platforms. Open content is new to the K-12 report this year, with interest driven by a growing range of open source textbooks and a wider recognition of the collaborative philosophy behind creating and sharing free content.

- > **Game-based learning** has grown in recent years as research continues to demonstrate its effectiveness for learning. Games for education span the range from single-player or small-group card and board games all the way to massively multiplayer online games and alternate reality games. Those at the first end of the spectrum are easy to integrate into the curriculum, and have long been an option in many schools; but the greatest potential of games for learning lies in their ability to foster collaboration and engage students deeply in the process of learning. Once educational gaming providers can match the volume and quality of their consumer-driven counterparts, games will garner more attention.
- > **Open content** is the current form of a movement that began a decade ago, when universities such as MIT began to make their course content freely available. Ten years later, schools have also begun to share a significant amount of curricula, resources, and learning materials. There is a growing variety of open content from K-12 organizations and schools, and in many parts of the world, open content represents a profound shift in the way students study and learn. Far more than just a collection of free online course

materials, the open content movement is increasingly a response to the rising costs of education, the desire to provide access to learning in areas where such access is difficult, and an expression of student choice about when and how to learn.

## Far-term Horizon

On the far-term horizon, set at four to five years away from widespread adoption are learning analytics and personal learning environments. Neither of these two

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technologies is commonly found in school settings today and both remain at the experimental and conceptual levels. Nonetheless, the high level of interest and research in each of these areas — not to mention their game-changing potential — indicates that they are worth following closely.

- > **Learning analytics** loosely joins a variety of data-gathering tools and analytic techniques to study student engagement, performance, and progress in practice, with the goal of using what is learned to revise curricula, teaching, and assessment in real time. Building on the kinds of information generated by Google Analytics and other similar tools, learning analytics aims to mobilize the power of data-mining tools in the service of learning and embrace the complexity, diversity, and abundance of information that dynamic learning environments can generate.

> **Personal learning environments (PLEs)** refer to student-designed learning approaches that encompass different types of content — videos, apps, games, social media tools, and more — chosen by a student to match his or her personal learning style and pace. Despite the use of the word “environment” in the name, the notion of a collection or a physical or online space is somewhat irrelevant to a PLE. The goal is for students to have more control over how they learn, and for teachers to set expectations that their students will be more engaged in understanding and applying their learning strategies. Personal learning environments are currently more of a theoretical construct, as they have not been widely put into practice. The notion is of intense interest to many educators who see PLEs as having considerable potential to engage students in ways that best suit their individual learning needs.

Each of these technologies is described in detail in the body of the report. These sections open with a discussion of what the technology is and why it is relevant to teaching, learning, and creative inquiry.

## At the center of the process is an international advisory board whose role is to select the topics in the report.

Examples of the technology in practice, especially in schools, are listed to illustrate how it is being adopted at the current time. Our research indicates that all six of these technologies, taken together, will have a significant impact on learning-focused organizations within the next five years.

### The NMC Horizon Project

Since March 2002, under the banner of the NMC Horizon Project, the New Media Consortium has held an ongoing series of conversations and dialogs with hundreds of technology professionals, campus technologists, faculty leaders from colleges and universities, teachers and other

school professionals, and representatives of leading corporations from more than two dozen countries. In the ensuing years, these conversations have resulted in the publication each January of a report focused on emerging technologies relevant to higher education. At the center of the process is an international advisory board whose role is ultimately to select the topics in the report, via a consensus-based process. As they work, the advisory board engages in lively dialogs around a wide range of articles, published and unpublished research, papers, scholarly blogs, and websites. The result of these dialogs is a list of the key technologies, trends, challenges, and issues that knowledgeable people in technology industries, higher education, and learning-focused organizations are thinking about.

In 2008, the NMC embarked on a new series of regional and sector-based companion editions of *The NMC Horizon Report*, with the dual goals of understanding how technology is being absorbed using a smaller lens, and also noting the contrasts between technology use in one area compared to another. This report, *The NMC Horizon Report: 2011 K-12 Edition*, is the third in the series focusing on pre-college education. The flagship *NMC Horizon Report*, focused on higher education, is translated into multiple languages every year. Over all editions, the readership of the reports is estimated at over 1,000,000 worldwide, with readers in more than 75 countries.

Like the university-focused effort from which it emerged, the K-12 project, referred to informally as *Horizon.K12*, uses qualitative research methods to identify the technologies selected for inclusion in the report, beginning with a survey of the work of other organizations, a close examination of topics previously detailed in *The NMC Horizon Report* series, and a review of the literature with an eye toward spotting interesting emerging technologies. When a new cycle is started, little is known, or even can be known, about the appropriateness or efficacy of many of the emerging technologies for these purposes, as The NMC Horizon Project expressly focuses on technologies not currently in widespread use in schools.

By engaging a wide community of interested parties, and diligently searching published research, the



Internet, and other sources, enough information is gathered early in the process to allow the members of the advisory board to form an understanding of how each of the discovered technologies might be in use in settings outside of education, to develop a sense of the potential the technology may have for educational settings, and to envision applications of the technology for teaching, learning, and creativity. The findings are discussed in a variety of settings — with teachers, industry experts, technologists, and of course, the Horizon advisory board. Of particular interest to the advisory board every year is finding educational applications for these technologies that may not be intuitive or obvious.

The 45 members of this year's K-12 advisory board were purposely chosen to represent a broad spectrum of K-12 education, as well as key writers and thinkers from business and industry. They engaged in a comprehensive review and analysis of research, articles, papers, blogs, and interviews; discussed existing applications, and brainstormed new ones; and ultimately ranked the items on the list of candidate technologies for their potential relevance to teaching, learning, and creative expression. This work took place entirely online and may be reviewed on the project wiki at [k12.wiki.nmc.org](http://k12.wiki.nmc.org).

Each *NMC Horizon Report* is produced over a period of just a few months so that the information is timely and relevant. This year, the effort to produce *The NMC Horizon Report: 2011 K-12 Edition* began in February 2011 and concluded when the report was released in June 2011, a period of just over three months. The six technologies and applications that emerged at the top of the final rankings — two per adoption horizon — are detailed in the sections that follow.

Each of those sections includes detailed descriptions, links to active demonstration projects, and a wide array of additional resources related to the six profiled technologies. Those profiles are the heart of *The NMC Horizon Report: 2011 K-12 Edition*, and will fuel the work of the NMC Horizon Project throughout 2011-12.

An important example of that work is the Horizon.K12 Toolkit. For the second year, the Consortium for School

Networking (CoSN), with the support of HP's Office of Global Social Innovation, is again preparing a K-12 toolkit to accompany the report, aimed at school and district leaders, board members, policymakers, teacher groups, and others. The toolkit, to be released under a Creative Commons license, will help these key groups maximize the impact of the report in their schools and help their constituencies gain an understanding of new applications of technology to support teaching and learning and successfully plan for their implementation.

For those wanting to know more about the processes used to generate *The NMC Horizon Report* series, many of which are ongoing and extend the work in the reports, we refer you to the report's final section on the research methodology.